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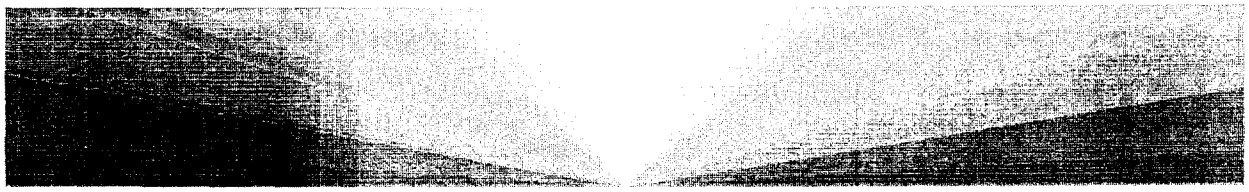
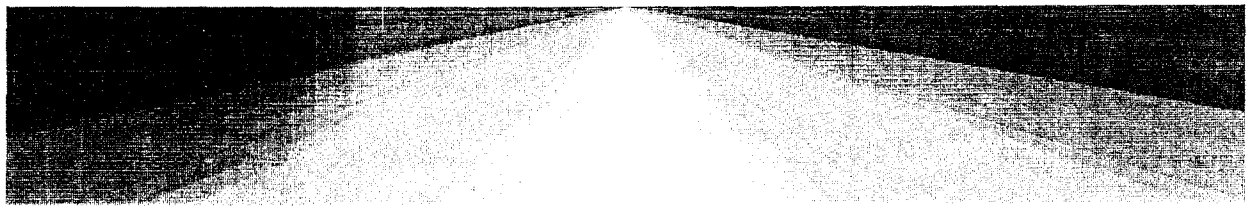
Rocky Flats Environmental Technology Site



Integrated Monitoring Plan – FY97



A Working Group consisting of:

City of Broomfield
City of Arvada
City of Westminster
City of Northglenn
City of Thornton
Colorado Department of Public Health and the Environment
Department of Energy, Rocky Flats Field Office
U.S. Environmental Protection Agency, Region VIII
The Kaiser-Hill Team

December 1997

Y39

Rocky Flats Environmental Technology Site

Integrated Monitoring Plan

December 1997

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ACRONYMS AND ABBREVIATIONS

AoIs	analytes of interest
AQM	Air Quality Management Program
CAA	Clean Air Act
CDPHE	Colorado Department of Public Health and the Environment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CLP	Contract Laboratory Program
ComRad	Community Radiation Program
COCs	contaminants of concern
CWA	Clean Water Act
D&D	decontamination and decommissioning
DMA	Discharge Monitoring Report
DOE	Department of Energy
DOE, RFFO	Department of Energy, Rocky Flats Field Office
DQO	Data Quality Objective
EcMPD	Ecological Monitoring Program Database
EPA	U.S. Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
GIS	geographic information system
IA	Industrial Area
IMP	Integrated Monitoring Plan
K-H	Kaiser-Hill Company
LEL	lower explosive limit
NPDES	National Pollutant Discharge Elimination System
OP	Operating Procedure
OU2	Operable Unit 2
PCBs	polychlorinated biphenyls
POC	point of compliance
QA/QC	quality assurance and quality control
RAAMP	Radioactive Ambient Air Monitoring Program
Rad-NESHAP	National Emission Standards for Hazardous Air Pollutants—Radionuclides
RCRA	Resource Conservation and Recovery Act (Colorado Hazardous Waste Act)
RFCA	Rocky Flats Cleanup Agreement
RFEDS	Rocky Flats Environmental Database System
RFSWD	Rocky Flats Soils and Water Database (formerly RFEDS)
SED	Sitewide Ecological Database
Site	Rocky Flats Environmental Technology Site
SSC	species of special concern

T&E	threatened and endangered
TAL	target analyte list
TDS	total dissolved solids
TSS	total suspended solids
USFWS	U.S. Fish and Wildlife Service
VOCs	volatile organic compounds
WARP	Well Abandonment and Replacement Program
WWTP	waste-water treatment plant

1. INTRODUCTION

Environmental monitoring programs at the Rocky Flats Environmental Technology Site (RFETS, or the Site) continue to evolve in response to new regulatory drivers and accelerated site closure. Various monitoring programs have amassed data on soils, surface water, groundwater, air, and different ecological systems. The Rocky Flats Cleanup Agreement (RFCA) requires DOE, in consultation with the Colorado Department of Public Health and the Environment (CDPHE) and the U.S. Environmental Protection Agency (EPA), to establish an Integrated Monitoring Program that effectively collects and reports the data required to ensure the protection of human health and the environment. The Program is consistent with the RFCA Preamble, and complies with RFCA itself, laws and regulations, and effective management of RFETS's resources. The Integrated Monitoring Plan (IMP) identifies the routine monitoring programs for surface water, groundwater, air, and ecology designed to minimize duplication of efforts among DOE, CDPHE, the cities of Broomfield and Westminster, and data management systems. Specific Site activities involve soil monitoring, but site-wide soil monitoring was discontinued in 1994, after many years of characterizing transuranic contaminant distributions across the Site.

The IMP captures the Site monitoring performed for a variety of legal, contractual, and operational purposes and restates the agreed-upon types of monitoring, monitoring locations, sampling frequencies, and purposes of the monitoring to meet the RFCA goal. In some instances, the IMP captures monitoring that is already legally required outside of RFCA. Where this is the case, such monitoring requirements are not subject to enforcement pursuant to RFCA, but may be subject to enforcement in accordance with the initiating legal requirements. The IMP Background Document[1] is not subject to enforcement under RFCA.

In developing the Integrated Monitoring Program, Site personnel met with a working group of representatives from the U.S. Environmental Protection Agency (EPA), the State of Colorado, and the Cities of Westminster and Broomfield to develop consensus on the types of data to be gathered and their eventual uses (the Data Quality Objectives, or DQOs, described below). The Program is designed to provide data that meet the DQOs by supporting operational and regulatory decisions, and address the following primary regulatory drivers:

[1] K-H. 1997. Rocky Flats Environmental Technology Site Integrated Monitoring Plan. Kaiser-Hill Company (June 30).

- The Resource Conservation and Recovery Act (RCRA)
- The Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA)
- The Clean Air Act (CAA)
- The Clean Water Act (CWA)
- Standards promulgated by the Colorado Water Quality Control Commission
- The body of regulations governing natural resource (ecological) management
- Site-specific monitoring and cleanup agreements
- DOE Orders and technical guidance.

1.1 INTEGRATED MONITORING PLAN

This Integrated Monitoring Plan (IMP) is based on the IMP Background Document,[1] which describes the activities being conducted at the Site under the Integrated Monitoring Program, and how each addresses RFCA and other regulatory requirements. The IMP Background Document also details how the data are used in Site decision-making processes. This IMP lists the monitoring programs to which DOE and the other stakeholders are committed. The IMP Background Document provides additional information on the DQO decision process and the regulatory framework, both of which drive many of the monitoring decisions at the Site.

Both the IMP Background Document and the IMP will change with time. Revisions in FY98 will incorporate monitoring being conducted by other entities (e.g., city or state agencies), as well as some monitoring that does not address specific decisions or regulations. In addition, monitoring programs are refined as Site remediation and closure efforts progress, new data become available, and data analysis techniques improve.

This IMP lists the ongoing environmental monitoring activities to which the DOE, the CDPHE, and the other stakeholders are committed and provides an overview of the requirements for these activities and the intended uses of the data produced. The Integrated Monitoring Program includes four primary surveillance programs to monitor surface water, groundwater, air, and ecological systems, and to examine—to a limited extent—the interactions among these environmental media. Each of these programs is described herein.

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1.2 DATA QUALITY OBJECTIVES

Representatives of DOE, the Rocky Flats Field Office (RFFO), Kaiser-Hill (K-H), and the various federal, State of Colorado, and local stakeholder agencies together developed a set of DQOs to ensure that environmental monitoring data would satisfy the requirements of the regulatory framework described above, and would prevent unacceptable risks to public health and the environment. The data will be used to model contaminant movement and identify contaminant concentrations that exceed pre-established limits; to support planning, implementation, and assessment of Site remedial and Decontamination and Decommissioning (D&D) activities; to address regulatory reporting requirements and commitments; and to monitor various ecological systems at the Site. Therefore, the data need to meet or exceed quality requirements to be useful in modeling, risk assessment, performance assessment, and compliance. The data must be of sufficient quality to withstand scientific and legal scrutiny, and they must be gathered using procedures that are appropriate for their intended use in making decisions for Site activities. Each environmental monitoring program includes a set of data usability requirements and procedures to ensure that high-quality data are produced.

All sampling procedures and analyses of surface water and groundwater adhere to general groundwater DQO guidance, and many also are subject to project-specific QA/QC criteria. The IMP Background Document details the overall QA/QC requirements, including field duplicate and blank samples, analytical detection limits, and standards for accuracy and completeness. A standardized set of Operating Procedures (OPs) ensures consistency in sampling and field measurement techniques, and all field sampling crews are trained in those techniques. Refer to the IMP Background Document for specific OPs and additional literature concerning QA/QC requirements.

2. SURFACE WATER

The surface water monitoring program at the Site addresses the requirements of statutes, regulations, orders, and agreements, and supports many decision-making processes. Surface water monitoring (summarized in Table 1) encompasses five areas:

- Site-wide water quality
- Quality of waters within the Industrial Area
- Quality of discharges from the Industrial Area
- Quality of water leaving the site
- Offsite water quality.

Protocols for sampling and analysis of surface water, as well as quality assurance and quality control (QA/QC) requirements, are defined in several documents. Refer to Section 2.1.5 of the IMP Background Document for details.

Site personnel enter surface water data into the Rocky Flats Soils and Water Database (RFSWD) (formerly the Rocky Flats Environmental Database System, or RFEDS), and the data can be retrieved to address specific purposes. Many of the data generated are not specifically reported in Site documentation, but rather are provided to requestors or decision makers as needed. However, regular reporting requirements are as follows:

- National Pollutant Discharge Elimination System (NPDES) permit compliance reporting requires monthly and annual preparation and delivery of the Discharge Monitoring Report (DMR) to EPA Region VIII.
- Pre-discharge and community assurance monitoring results gathered by the State are reported routinely to the Site and nearby cities.
- Exceedances of RFCA standards and action levels are reported to EPA and CDPHE.
- The bulk of the surface water data collected are summarized and reported at Quarterly Information Exchange Meetings, which have been held since 1972
- Site-wide information is presented in the Annual Site Surface Water Quality and Quantity Summary.

TABLE 1. SURFACE WATER MONITORING MATRIX

Type of Monitoring	Locations	Sampling Frequency	Sampling Peformed By	Purpose
Site-Wide				
Dam Operations	All detention ponds	Various regular intervals	Site personnel	Assess need for discharges from ponds to ensure dam integrity
Streamflow	4 stream locations	Continuous when flowing	Site personnel	Determine streamflow upgradient of Ponds A3, A4, B5, and C2
Inflow Rates and Pond Elevations	3 pond locations	Daily (hourly if needed)	Site personnel	Monitor amount of water detained in Terminal Ponds A4, B5, and C2
Piezometers	Dams at Ponds A3, A4, B1, B3, B4, B5, and C2	Continuous	Site personnel	Monitor level of saturated zone in detention structures
Dam Integrity Inspections	12 locations on dams	Various	Site personnel, FERC, and DOE	Assess physical integrity of earthen dams
Ad Hoc	Varies	As needed[1]	Site personnel	Address need for special monitoring
New Contaminant Sources	Varies	As needed[1]	Site personnel	Identify source(s) of any new contamination detected by the surface water monitoring program
Performance Monitoring	Varies	As needed[1], generally from 18 months before project start-up to 3 months after completion	Site personnel	Establish baseline conditions and monitor effects of Site activities on water quality
Plutonium Correlation	POCs, plus 10 additional locations	As needed[1]	Site personnel	Correlate plutonium concentrations to levels of more easily measurable parameters
Industrial Area				
New Source Detection	5	As needed[1]	Site personnel	Detect changes in AoI concentrations or water quality parameters that might indicate new contamination
Incidental Waters	Varies	As needed[1] (100–200 events/yr on average)	Site personnel	Determine acceptable disposal method

[1] Sampling frequency is determined based on Site Procedures (refer to IMP Background Document for more information).

Table 1. (cont.)

Type of Monitoring	Locations	Sampling Frequency	Sampling Performed By	Purpose
Industrial Area Discharges to Ponds				
Stream Segment 5	3 action level framework (ALF) locations	Monthly (total approx. 85 samples)	Site personnel	Monitor compliance with RFCA action levels
Internal Waste Streams	Discharges from buildings, WWTP, terminal ponds, and cooling towers, plus any new discharges	Various intervals, depending on location	Site personnel (EPA Region VIII conducts annual NPDES permit inspections)	Confirm NPDES permit compliance
Discharges to WWTP	New waste streams	As needed[1]	Site personnel	Consider for discharge to WWTP
WWTP Collection System	2 locations in collection system	Regular intervals specified in Site Procedures	WWTP (Site) personnel	Check for signs of corrosivity and monitor LEL
NPDES-Permitted Discharges	WWTP outfall and terminal pond discharges	Specified in NPDES permit	Site personnel	Demonstrate permit compliance and provide data for permit updates
Water Leaving the Site				
Predischarge	8–10 events/yr (1 per yr at C2)	Ponds A4, B5, and C2	Site personnel (CDPHE analyzes samples)	Determine quality of water to be discharged from terminal ponds
Terminal Ponds	3 terminal ponds	Frequency specified in NPDES permit	Site personnel	Verify that industrial discharges do not endanger waters of the U.S.
Segment 4	5 stations	3 samples for each of 8–10 discharge events, plus 1–2 samples per month during baseflow between discharges	Site personnel	RFCA Point of Compliance monitoring
Non-POC at Indiana St.	Walnut Cr. & Woman Cr. Drainages	Total of 21 samples annually	Site personnel	Assess effects of flow changes on nutrient loads in water leaving the site

Table 1. (cont.)

Type of Monitoring	Locations	Sampling Frequency	Sampling Performed By	Purpose
Offsite				
Uncharacterized Discharges	5 primary locations, but could vary with circumstances of discharge	As needed[1]	Site personnel	Assess impact of uncharacterized discharges on community water supply facilities
Community Assurance	4 points in Westminster and Broomfield water treatment process streams	Weekly, with samples composited semi-annually or annually	Westminster and Broomfield municipal employees	Notify municipalities in the event of water quality exceedances; provide data for dose reconstruction studies

[1] Sampling frequency is determined based on Site Procedures (refer to IMP Background Document for more information).

2.1 SITE-WIDE WATER QUALITY

This section deals with surface water monitoring that is not confined to a particular area of the site. Site-wide monitoring includes:

- Monitoring the dams that form the Site detention ponds (these dams lie within a defined area, but monitoring to ensure their effectiveness is also performed as part of the Site-wide monitoring program)
- Locating the source of any contamination detected by the monitoring described in subsequent sections of the IMP
- Specific monitoring activities in response to requests (i.e., *ad hoc* monitoring)
- Monitoring to establish a correlation between plutonium concentrations and levels of indicator parameters.

The Site-wide monitoring is described below.

2.1.1 Monitoring Dam Operations

The Site detention ponds (Figure 1) are formed by earthen dams, which are designed for storm water detention. Water is routinely discharged from the ponds as levels rise, after water quality is determined to meet downstream standards. Although water rarely rises to the elevation of emergency spillways, if that were to happen, there is a risk that the dams could fail or sustain damage. The resulting potential risk to public health and the environment from breaching of a dam could be far greater than that posed by the low contaminant levels that could exist in the pond water.

Site personnel use data from the monitoring activities listed below, along with water quality data from the ponds, within a specific decision-making process (see IMP Background Document, section 2.2.1 and ancillary documents cited therein) to determine if and when water should be released from the ponds. Site personnel perform the following monitoring activities:

- Measure streamflow upgradient of Ponds A3, A4, B5, and C2.
- Monitor inflow rates and pond elevations continuously in terminal ponds A4, B5, and C2 (daily monitoring is adequate for normal operations, and hourly monitoring is invoked as established by procedure [e.g., in response to storms] to ensure dam safety).
- Monitor piezometers installed in the dams to track the level of the saturated zone in the earthen detention structures.

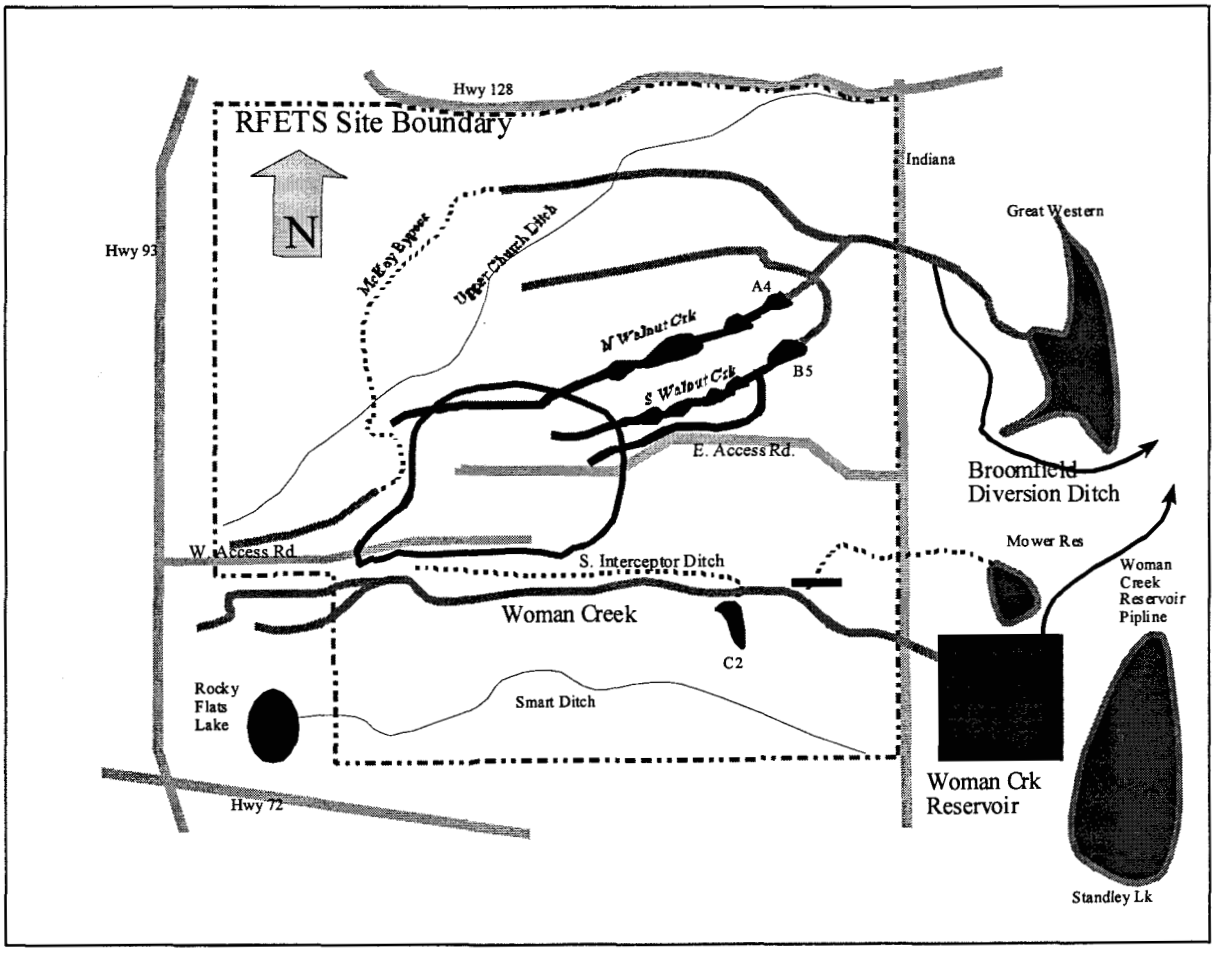

Figure 1. Conceptual surface water map.

- Evaluate dam integrity through visual inspections at appropriate frequencies as determined by procedure, and gather telemetry data daily to hourly on the three terminal dams that have inclinometers.
- Perform routine integrity inspections on dams on all 12 ponds at appropriate frequencies as determined by procedure, and perform a detailed internal inspection biannually. In addition, the Federal Energy Regulatory Commission (FERC) and DOE also inspect the dams externally on an annual basis.
- Monitor movement of the crest monument as required by the Colorado State Engineer's dam safety regulations.

- Monitor the inclinometers and evaluate dam crest movements quarterly to identify any movement of dam structure.
- Exercise the valves in the outlet works of the terminal dams to ensure operability, as directed by the Office of the State Engineer.

Data are input into a spreadsheet model to assess the need for discharge, based on the pond operations plan. Meteorological data are also used in the model, along with discharge rates as applicable.

2.1.2 *Ad Hoc* Monitoring

Ad hoc monitoring is designed to address specific identified data needs. The data needs arise in response to circumstances that are not addressed by the routine monitoring program. *Ad hoc* monitoring falls into one of two categories:

- *Required.* Statutory, regulatory, permit, or order requirements that monitoring must be done to obtain analytical data
- *Discretionary.* Where analytical data could help with further decision making, or a need for additional data is otherwise strongly indicated.

Ad hoc monitoring may be conducted in response to events such as unusual precipitation volumes, community concerns, changes in permit or regulatory requirements, construction projects, or spills.

2.1.2.1 Locating New Contaminant Sources

If new contamination is indicated by surface water monitoring activities, Site personnel use portable sampling equipment to determine its source. This monitoring may cross the boundaries of other surface water monitoring programs. For instance, if contaminants are detected outside the Industrial Area (IA), portable sampling equipment is deployed inside the IA to locate the source.

2.1.2.2 Performance Monitoring

Performance monitoring may be specified for individual projects (e.g., D&D or remedial activities) within the Industrial Area. In general, such project-specific monitoring begins 18 months before the project starts, to establish baseline conditions, and continues for 3 months after project completion. Site personnel have conducted performance monitoring recently at Buildings 886, 779, and 123.

2.1.3 Monitoring for Correlation of Plutonium with Indicator Parameters

Site personnel continue to study whether a correlation can be established between plutonium concentrations and levels of indicator parameters that can be measured frequently, or even continuously, at much less expense than radiochemically analyzing samples for plutonium. For instance, total suspended solids (TSS) concentrations may provide an indication of plutonium concentrations, because plutonium and other radionuclides tend to adsorb strongly to particulate matter in surface water. Although measuring TSS requires a laboratory analysis, the lag time between sample collection and data delivery is considerably shorter than for a radiochemical analysis. Turbidity, which can be measured continuously, may also correlate with plutonium concentrations. If so, continuous turbidity measurements would provide an early indication of potential rising plutonium concentrations, improving the protection of public health and the environment. The technical hurdle in this effort remains the issue of sensitivity: identifying correlations at very low concentrations challenges the available analytical methods.

Plutonium concentrations are already being monitored at the terminal pond outfalls and at the Indiana Street RFCA Points of Compliance (POCs). Personnel also monitor TSS concentrations occasionally at these five stations. In addition, they monitor TSS and turbidity at stations SW022, GS10, SW093, SW091, and SW027, which are located sufficiently upstream in Segment 5 that they would provide at least 2 hours warning before exceedances could occur in Segment 4. Personnel also monitor air temperature and precipitation at several locations.

Statisticians will evaluate the data from this monitoring program to study the correlation between plutonium concentrations and levels of indicator parameters. Based on this analysis, this monitoring program may be adjusted (or discontinued) in the future to further define any correlations observed.

2.2 WATER QUALITY WITHIN THE INDUSTRIAL AREA

Site personnel monitor waters within the Industrial Area to detect new sources of contamination, to assess the performance of facilities or project elements (e.g., during closure of a facility) in preventing releases of specific constituents, and to monitor the quality of incidental rainwater or snowmelt that may accumulate in utility pits and bermed areas. Indications of a contaminant release would trigger reporting and decision-making for response and/or remediation.

2.2.1 New Source Detection

Site personnel collect surface water samples at stations SW022, SW091, SW093, SW027, and GS10, which are located in the upper reaches of the three main drainages and through which runoff leaves the Industrial Area. Analytes of Interest (AoIs) include plutonium, uranium, and americium isotopes; water quality parameters, including turbidity, pH,

nitrate (NO_3), and conductivity (measured every 15 minutes); and precipitation data (measured continuously at SW022) and flow rate (measured continuously). Additional AoIs also may be identified.

The "indicator parameters"—those that can be and are monitored continuously—provide a qualitative early warning of potential contaminant releases without the long turnaround time or cost of more frequent sample analyses for the specific contaminants. For example, plutonium and americium concentrations are generally correlated with TSS and turbidity, and plutonium may be correlated with nitrate concentrations. Additionally, levels of chromium, beryllium, silver, and cadmium may correlate with conductivity readings. If a continuously monitored parameter provides cause for concern about a particular contaminant, samples will be collected and analyzed for that contaminant.

2.2.2 Incidental Waters

Approximately 100–200 occurrences of incidental water at the Site require monitoring each year. Waters that accumulate in utility pits, berms, footing drains, sumps, and excavation sites, or that are released within buildings or onto the ground, are evaluated using field screening observations and measurements, coupled with the process knowledge of Site personnel. Additional analysis is required if the circumstances or field observations provide cause to suspect the presence of oil or hazardous/radioactive constituents.

The program for monitoring incidental waters provides for routine, data-driven decision making on whether to allow discharge of these waters into the environment without treatment. In evaluating incidental water, field personnel estimate the volume of water present, note its appearance (especially its color or presence of a visible sheen), and field test its pH, nitrate level, and conductivity. In conjunction with knowledge of the processes occurring in the immediate vicinity, these data guide the process of deciding how to dispose of the incidental waters. Waters that cannot be discharged to the environment may be considered for discharge to the WWTP (under internal waste-water stream rules) or may be managed under other applicable regulations.

2.3 INDUSTRIAL AREA DISCHARGES TO PONDS

Industrial Area discharges to the terminal ponds include surface water runoff, discharges from the waste-water treatment plant (WWTP), and waters in Segment 5 (including the stream channels and interior ponds). Site personnel conduct the following activities under this portion of the surface water monitoring program:

- Monitor Segment 5 water quality
- Characterize internal waste-water streams for NPDES permit compliance
- Monitor influent to the WWTP

- Monitor the WWTP collection system
- Monitor NPDES-regulated discharges to the ponds.

2.3.1 Stream Segment 5

Site personnel monitor Segment 5 water quality (as represented by stations SW093, SW027, and GS10) for compliance with RFCA action levels. Exceedances require development of a response action plan.

The RFCA Action Level Framework provides criteria for identified contaminants. A subset of these contaminants are monitored under this portion of the Program (see Table A-26 in the IMP Background Document). Personnel collect samples monthly from each station, for an estimated total of 85 samples during the year (see Table 2-10 in the IMP Background Document). The number of samples collected from each station is determined using historical flow data, collecting 15 L of water for each 500,000 gallons of stream flow to a maximum of four per month, and ensuring that each 15-L sample composite contains no less than 50 flow-paced grab samples.

Collecting only one sample per month and analyzing only for the AoIs listed above for incidental waters would be sufficient to comply with RFCA requirements. However, the higher number of samples reduces the chance of recording a false exceedance or of missing a short-duration contaminant surge. Sampling frequency may be adjusted to accommodate changing data needs.

2.3.2 Characterization of Internal Waste-Water Streams

Data on internal waste-water streams are used to make decisions regarding the disposition of contaminated waste water produced on the Site. Monitoring is needed, because some waste water requires treatment and some can be discharged to the WWTP. The data are used to determine whether discharges to the WWTP are compatible with the activated sludge, whether the discharge exceeds the facility's ability to handle it, and whether the discharge complies with the Site's NPDES permit.

The existing NPDES permit also covers all discharges to surface water (including the WWTP outflow). Site personnel use monitoring data to maintain the permit and to renew the permit every 5 years. Both permit maintenance and renewal may require modifying specific conditions, particularly as Site closure activities accelerate. (Note: A new NPDES permit for the Site is anticipated to be effective January 1, 1998.) The NPDES permit specifies all managed and incidental discharges to be monitored, including all sanitary discharges and process waste-water streams from Site buildings, along with discharges from Building 374, the WWTP, and the terminal ponds. Any new waste-water streams must be characterized and monitored as well. In addition, the cooling towers are being monitored pending a decision on whether their discharge should be included in the

permit. Site personnel must fully disclose all waste-water streams to EPA Region VIII, which conducts annual NPDES permit inspections of the Site to enforce this disclosure requirement.

2.3.3 Monitoring Discharges to the WWTP

Any new waste-water streams generated on the Site must be evaluated to determine how best to dispose of them. Most can be discharged to the WWTP under the terms of the NPDES permit, but some cannot. The latter must be disposed of in accordance with applicable requirements. Site personnel screen all waste-water streams for visible sheen, color, clarity, volume, field conductivity, and pH. However, the most important factor in determining the means of disposal is knowledge of the specific process that produces the waste water. This information is considered in making decisions regarding disposal of waste-water streams.

2.3.4 Monitoring the WWTP Collection System

WWTP personnel regularly check the WWTP collection system at two locations for pH, conductivity, and lower explosive limit (LEL). They also take manual pH readings at the headworks. Conductivity and pH are indicators of corrosivity, which could damage the treatment equipment, and LEL readings are taken to ensure worker safety. Additional monitoring activities may be added to ensure that the plant effectively processes waste waters that change as Site closure activity increases.

2.3.5 Monitoring NPDES Discharges to Ponds

NPDES-permitted discharges into and from the ponds are described in the next section. The only NPDES-permitted discharge monitored upstream of the ponds is the WWTP outfall at Building 995. The monitoring requirements for the WWTP outfall are the same as those for discharges in and below the ponds.

2.4 WATER LEAVING THE SITE

Water leaves the Site in Stream Segment 4 at Indiana Street, and personnel perform four categories of monitoring to assess its quality:

- Predischarge monitoring
- NPDES monitoring of terminal ponds
- RFCA compliance monitoring of Segment 4
- Additional, non-Point-of-Compliance (non-POC) monitoring.

2.4.1 Predischarge Monitoring

Before water is discharged off Site, it must be evaluated for a range of constituents to ensure that unexpected contaminants have not been introduced. Therefore, Site personnel collect predischarge samples 8 to 10 times per year at in the Walnut Creek Drainage at Ponds A-4 (North Walnut Creek) and B5 (South Walnut Creek), once per year in the Woman Creek Drainage at Pond C2, and as needed from any other pond temporarily functioning as a terminal pond. CDPHE analyzes the samples for an extensive list of constituents, including inorganic compounds, metals, volatile and semivolatile organic compounds, radiologic parameters, herbicides, and pesticides. The sampling and analyses are conducted far enough in advance of a planned discharge to allow action to be taken if exceedances are noted, but near enough to the time of discharge to be representative of the discharge composition.

2.4.2 NPDES Monitoring of Terminal Ponds

The current NPDES permit requires that discharges from some terminal ponds and from the WWTP be monitored to verify that industrial point-source discharges from the Site do not endanger waters of the United States. The permit specifies the analytical parameters and estimated sampling frequency (see Tables 2-15 and 2-16 in the IMP Background Document). Data are provided to the regulators for their use in making decisions regarding ongoing monitoring needs and response actions.

2.4.3 Segment 4 Compliance Monitoring

Site personnel perform RFCA Point-of-Compliance (POC) monitoring at five stations in Segment 4 (GS11, GS08, GS31, GS03, and GS01). POC monitoring is concerned primarily with concentrations of plutonium, americium, and tritium, although additional analytes are monitored in a subset of samples (see Table 2-16 in the IMP Background Document for analyte list and sampling requirements). At least three samples are collected for each pond discharge event (approximately 8 to 10 discharge events per year), and flow-proportional sampling is conducted when flow rates are sufficient to obtain required water sample volumes.

2.4.4 Non-POC Monitoring at Indiana Street

Various offsite reservoir construction and water diversion projects will cause changes in the surface water flow regime. Site personnel conduct additional monitoring to assess the effects of these flow changes on nutrient loads in water leaving the Site. They collect samples annually from Walnut Creek to assess the composition of the water when it consists of:

- 100% Site effluent (five samples)
- Mixed effluent and natural stream flow (five samples)
- 100% natural stream flow (five samples).

In addition to these 15 samples, they collect 5 samples from Woman Creek during times when Pond C2 is not discharging, and 1 sample during Pond C2 discharge. All 21 samples are analyzed for total ammonia, nitrite, nitrate, phosphate, orthophosphate, uranium isotopes, beryllium, cadmium, silver, and chromium (in the future, the latter four metals may be deleted from the analyte suite, depending on initial water quality results).

2.5 OFFSITE MONITORING TO SUPPORT COMMUNITY WATER SUPPLY MANAGEMENT

Site and CDPHE personnel provide monitoring data to nearby communities for their use. Procedures are in place to monitor uncharacterized discharges from the Site and to provide data that address public concerns regarding water quality.

2.5.1 Monitoring Uncharacterized Discharges

Surface water of unknown quality could potentially leave the Site under various circumstances, including but not limited to the following situations:

- Unmonitored storm flow exceeds the capacity of Broomfield's diversion ditch and enters Great Western Reservoir
- Predischarge monitoring is followed by a storm event before or during the discharge, so that a fraction of the discharge is uncharacterized
- An emergency discharge leaves the Site without being characterized (e.g., the type of scenario exemplified by the May 1996 15-year storm event).

Monitoring activities include gathering flow data at five locations to assess the Site's contribution to total flow leaving the Site and to determine the potential for Walnut Creek to exceed the capacity of Broomfield's diversion ditch.

If an uncharacterized discharge were to occur, personnel would collect samples for determination of water quality. Sampling locations would be determined based on the circumstances of the discharge, but locations of interest include Woman and Walnut Creeks at Indiana Street, Great Western Reservoir, Woman Creek Reservoir, Mower Reservoir, and Broomfield's water treatment plant. The water chemistry and flow data can be combined to assess the overall impact of an uncharacterized discharge.

2.5.2 Community Assurance Monitoring

Municipal employees collect samples from four key points in the water treatment process streams of the cities of Westminster and Broomfield:

- Raw water influent from Great Western Reservoir
- Treated water effluent from the Great Western Reservoir's treatment facility[2]
- Broomfield Service Area of Broomfield's water distribution system
- Denver Service Area of Broomfield's water distribution system.

Employees collect grab samples each week at these points and composite the samples quarterly for the reservoir influent and effluent, and semi-annually for the two Broomfield service areas. The Radiation Control Division of the CDHPE analyzes the composites and samples of finished drinking water for plutonium, americium, uranium, and tritium.

Community officials are to be notified in the event of a significant change in the levels of these constituents. The data also serve to quantify constituent loading to the treatment systems, assess the effectiveness of the treatment systems, and provide baseline low-level dose data for use in dose reconstruction studies (such as the one sponsored in the 1990s by the DOE, RFFO [Rocky Flats Field Office]).

[2] The City of Broomfield ceased using the Great Western Reservoir/Treatment Plant for city drinking water in July 1997.

3. GROUNDWATER

3.1 PURPOSE

Most of the groundwater at the Site either discharges to surface water bodies or is hydraulically connected to surface water. The groundwater monitoring program (Table 2) is designed to protect Site surface water resources, identify contaminated groundwater, and track any movement of known contaminant plumes. Site personnel use the data to delineate potential pathways to surface water, enabling them to detect any movement of contaminants off the Site.

The groundwater monitoring program is designed to accomplish the following:

- Detect and identify contaminants in groundwater, and monitor their concentrations
- Identify contaminant sources, and monitor remediation efforts
- Delineate contaminant pathways
- Assess the effects of Site remediation and closure activities
- Protect groundwater from new sources of contamination
- Evaluate any effects of contaminated groundwater on surface water.

3.2 MONITORING FOCUS

Several contaminant plumes have been identified in Site groundwater (see Appendix D and Plate 3 in the IMP Background Document). The main contaminants of concern (COCs) are volatile organic compounds (VOCs), which originated from the Site's historical chemical use and storage during its years of producing nuclear weapons components. Possible sources of contaminants that could affect groundwater include storage tanks, the process waste-water system, drains, sumps, historical storage areas, and spills. The monitoring scope is designed to be conducted before, during, and after Site operations that may affect groundwater quality.

Site personnel determine the concentrations of groundwater AoIs and compare them to established background levels, as well as to Site action levels or standards. They evaluate exceedances of these criteria to determine whether the data demonstrate an ongoing trend, and they factor the presence or absence of discernible trends into the Site decision-making process (see section 3.4.2 of the IMP Background Document) to assess the need for new remediation efforts or changes in ongoing activities.

TABLE 2. GROUNDWATER MONITORING MATRIX

Type of Monitoring	Locations	Sampling Frequency	Purpose
Sample for determination of analyte concentrations	89 wells	Semi-annual	Monitor analyte concentrations in groundwater
Water-level measurement	77 wells[1]	Monthly	Characterize groundwater flow regime
Water-level measurement	59 wells[1]	Quarterly	Characterize groundwater flow regime
Water-level measurement	25 wells[1]	Real-time	Characterize groundwater flow regime

[1] These wells are a subset of the 89-well network.

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Water-level measurements are incorporated into water elevation maps and hydrographs to define groundwater gradients and flow rates. Both the program for measuring water levels and the sampling and analysis program provide temporally related data for use in direct comparisons from year to year.

3.3 MONITORING PROGRAM

The groundwater monitoring program comprises the following components (see Appendix E in the IMP Background Document):

- Semi-annual sampling in a network of 89 wells
- Monthly measurement of water-table elevations in 77 of the 89 wells
- Quarterly measurement of water-table elevations in 59 of the 89 wells
- Real-time measurement of water-table elevations in 25 of the 89 wells
- Data interpretation and reporting
- Database management
- Well abandonment and replacement program (WARP).

3.3.1 Well Locations

Wells have been installed along known or suspected pathways between contaminated areas and outlets to surface water. The majority of the wells are located around the perimeter of the Industrial Area, the former Operable Unit 2 (OU2), and the existing landfill. Additional wells are located within the Site drainages, because stream flow is ephemeral. Boundary wells are maintained at the downgradient (eastern) Site boundary to confirm that contaminants are not migrating off Site. On-Site wells fall into seven categories:

- Plume definition
- Plume extent
- Drainage
- Boundary
- Performance
- Closure activities
- RFCA, which covers monitoring of permitted waste-water storage units.

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3.3.2 Groundwater Sampling and Analysis

Field crews measure groundwater temperature, pH, specific conductance, turbidity, and alkalinity, and submit a sample to a laboratory for measurement of total dissolved solids. They collect filtered samples for determination of metals concentrations and uranium isotopes. They also collect unfiltered samples for organics analyses, water quality determination, and measurement of all other radionuclides. Analytes of concern vary among wells, depending on the particular constituents in the plume being monitored. The scopes of work for the analytical laboratories contain complete target analyte lists (TALs).

The groundwater flow regime at the Site is such that sample volumes from some wells may be limited. If an available sample volume precludes determination of the entire analyte suite for a particular well, the analyses are performed in the following order of priority:

- VOCs (CLP Method 524.2)
- Semivolatile organic compounds
- Pesticides and polychlorinated biphenyls (PCBs)
- Nitrate/nitrite, as nitrogen
- Screening analysis for radionuclides
- Metals (TAL, plus cesium, lithium, strontium, tin, molybdenum, and silica)
- Any specific metals for a particular well (see TALs)
- Uranium-233/234, -235, -238
- Strontium-89/90
- Plutonium-239/240 and americium-241
- Major anions (chloride, fluoride, sulfate, carbonate/bicarbonate)
- Tritium.

3.4 DATA DISPOSITION

3.4.1 Databases

Site personnel enter all field data and analytical data into the Rocky Flats Soils and Water Database (RFSWD). They maintain data integrity through the use of standard data entry Operating Procedures (OPs) and by running error-checking routines when loading data.

Data can be extracted for various uses, including using the geographic information system (GIS) to map constituent distribution, and using various analytical models to assess groundwater movement and constituent migration.

3.4.2 Reporting

Groundwater monitoring activities are reported through the following vehicles:

- RFCA Annual Groundwater Report: The Annual Groundwater Report replaced various previously required reports and serves as the primary compliance report. It describes monitoring activities, identifies exceedances of pre-established groundwater quality standards, describes trends and contaminant movement, characterizes the Site hydrologic regime, and recommends improvements to the groundwater monitoring program.
- RFCA Quarterly Reporting: These data replace all previous quarterly reporting, integrating the elements of each regulatory driver into a single reporting vehicle. Quarterly reporting at the State Exchange of Information Public Meeting summarizes data gathered during the reporting period and also provides notification of any exceedances of RFCA groundwater quality standards.
- IMP: The IMP is the vehicle for changing required groundwater monitoring program elements. It is reviewed and updated annually.

3.5 WELL ABANDONMENT AND REPLACEMENT PROGRAM (WARP)

Section 3.6.7 of the IMP Background Document describes the WARP, which specifies the approval process for well installation and ensures proper recording and registration of all well installation activities. Site personnel maintain a database of all well locations, construction, permitting, and other relevant information. They also maintain a core repository for use in hydrological and geological characterization.

Wells are considered for abandonment if they are damaged or poorly constructed (or construction details are unknown), if they present a potential for cross contamination of other wells or the aquifer, or if they are no longer needed. Activities conducted under the WARP are reported in the RFCA Annual Report.

4. AIR QUALITY

4.1 PURPOSE AND PROGRAMS

The air monitoring activities on the Site (Table 3) assist in protecting the public and the environment by detecting and tracking the impacts of Site operations on air quality at and near the Site, characterizing any airborne materials that may be introduced, and monitoring the meteorologic conditions that influence the transport and dispersion of airborne materials. Data are used to plan, implement, and assess the effects of on-Site activities, including operations, construction, and closure activities; to maintain emergency preparedness; and to demonstrate compliance with relevant regulations.

The Air Quality Management (AQM) program develops the scope of air monitoring and reporting activities required to maintain compliance with applicable air quality regulations and DOE orders. In addition, CDPHE conducts oversight monitoring

4.1.1 Ambient Air Monitoring

The AQM program monitors ambient air quality both on- and off-Site, while CDPHE monitoring stations are located on-Site and at the Site perimeter. The purpose of these monitoring stations is to characterize any site-related airborne emissions. Five additional stations monitor airborne plutonium concentrations. These stations are operated independently by members of the communities of Arvada, Westminster, Broomfield, and Northglenn (the Community Radiation Program, or ComRad).

4.1.2 Effluent Monitoring

Air emissions (effluents) from all Site facilities that contain radioactive materials are monitored continuously to verify the effectiveness of radiation control mechanisms. Emissions data are used as part of the evaluation process to keep radioactive emissions as low as reasonably achievable.

4.1.3 Meteorological Monitoring

Instruments continuously monitor meteorologic conditions to generate data for use in air dispersion models that predict the transport of airborne emissions. Site personnel use model predictions to evaluate site operations and closure projects, and for emergency preparedness.

TABLE 3. AIR MONITORING MATRIX

Type of Monitoring	Locations	Sampling Performed By	Sampling Frequency	Purpose
Ambient air	35 samplers	RAAMP	Continuous	Detect and characterize Site-related airborne emissions
	Additional samplers on Site and at perimeter	CDPHE	Continuous	Detect and characterize Site-related airborne emissions
Effluent from Industrial Area facilities	52 exhaust outlets	Site personnel	Monthly from significant sources; annually from insignificant sources (filters collected monthly and composited)	Verify effectiveness of radiation control mechanisms
Meteorology	1 tower with instruments at 10, 25, and 60 m high; 1 backup tower with instruments at 10 m high	Site personnel	Continuous	Monitor meteorologic conditions for use in air quality modeling
	5 towers at Site perimeter	CDPHE	Continuous	Provide data as needed for emergency response modeling

4.2 AIR MONITORING SCOPE

Ambient air monitoring and effluent monitoring are intended to satisfy requirements of National Emission Standards for Emissions of Radionuclides Other Than Radon from DOE Facilities (Rad-NESHAP) and DOE orders. CDPHE and ComRad perform additional, independent air monitoring.

4.2.1 Ambient Air

The Radioactive Ambient Air Monitoring Program (RAAMP) collects ambient air data. The RAAMP network comprises 35 samplers. Twenty-three of the samplers are used to assess localized impacts of Site remediation projects and as sampling points in the event of a release. The other 12 are included in a proposal to satisfy CAA Rad-NESHAP monitoring requirements. The samplers run continuously, collecting airborne particulates on pairs of filters that represent different size fractions. Personnel collect the filters regularly, submitting them for analysis for specific isotopes of plutonium, uranium, and americium. The IMP Background Document details specific sampling intervals and analytical detection limits.

The CDPHE also operates air samplers on Site and at the perimeter. The two monitoring networks serve as independent measures of public exposure to radioactive releases, and they also monitor additional analytes, including beryllium, nitrogen dioxide, and non-radiologic pollutants regulated under the National Ambient Air Quality Standards.

4.2.2 Effluent

Exhaust air emissions from all Site facilities that contain radioactive materials (52 locations in the Industrial Area) are monitored by analyzing filter samples taken from the exhaust systems. Filters are analyzed monthly from sources considered to be "significant" (i.e., having the potential to contribute more than 0.1 millirem per year effective dose equivalent to any member of the public). Filters are collected monthly from "insignificant" sources, and these filters are composited and analyzed annually. In addition to analyzing filters for plutonium, uranium, and americium isotopes, samples are collected twice weekly at five locations for tritium analysis.

4.2.3 Meteorologic Conditions

A 61-m tower is located in the northwest part of the Buffer Zone, with monitoring instruments at 10, 25, and 60 m above the ground. A separate 10-m tower nearby provides backup data. Instruments measure wind speed and direction, temperature, relative humidity (dew point), and solar radiation, and calculate atmospheric stability class.

CDPHE owns five meteorological towers located about the Buffer Zone perimeter, and they provide data from these towers as needed to support Site emergency response modeling.

4.3 DATA DISPOSITION

In addition to using air quality data to demonstrate compliance with air quality regulations, Site personnel also use the data to support assessments of Site operations. They use the effluent monitoring data to ascertain the effectiveness of filters, and the ambient and meteorological data to run models that evaluate the effectiveness of administrative controls.

Constituent concentrations in effluent samples are coupled with meteorological data in models that estimate dose. Modeled exceedances of established dose levels would trigger reporting and response procedures. Personnel also evaluate ambient air data, and exceedance of air quality standards would trigger similar actions. RAAMP data are used to confirm that controls on radioactive emissions are operating effectively. Meteorological data are also used to model possible impacts during emergencies and emergency exercises.

5. ECOLOGY

The Buffer Zone around the Industrial Area at the Site is one of only a few areas along Colorado's Front Range that has remained largely undisturbed by encroaching development. The Buffer Zone contains several unique assemblages of animals and vegetation, and the ecological monitoring activities described in this section have been designed by DOE and its contractors to protect these valuable natural resources. Five major vegetation communities have been identified at the Site:

- Xeric tallgrass prairie
- Tall upland shrubland
- Great Plains riparian woodland complex
- High-quality wetlands
- Mesic mixed grassland.

Ecological monitoring is designed to protect wildlife in the buffer zone, including any special-concern species (i.e., threatened, endangered, candidate, proposed, state-listed, or other sensitive species). The Preble's meadow jumping mouse is of particular concern, because it has been proposed for listing as a threatened or endangered species. The U.S. Fish and Wildlife Service (USFWS) is considering the proposal, and in the meantime, studies of the Preble's meadow jumping mouse are being conducted in anticipation of developing a habitat conservation plan for the site. Such a plan would be developed jointly by the USFWS and DOE, RFFO.

5.1 MONITORING OBJECTIVES

The Ecological Monitoring Program (summarized in Table 4) is designed to provide data that can be used in management and conservation decision making during Site cleanup activities that will occur over the next decade. Data also demonstrate compliance with applicable natural resource protective regulations.

Site ecologists monitor key variables in the five vegetation communities and other habitats, and changes in any of these variables would trigger ecological protection and compliance decision making. Comparisons of monitoring data from year to year enable ecologists to detect changes, identify potential causes, and plan corrective actions for changes that result from Site activities, rather than from natural fluctuations.

TABLE 4. ECOLOGICAL MONITORING MATRIX

Type of Monitoring	Basis for Monitoring	Number of Locations	Sampling Frequency	Purpose of Monitoring
Bird Transect Surveys	Manage and conserve migratory bird species numbers and richness; comply with Migratory Bird Treaty Act.	20 Transects	15 times per year	Track changes in numbers and richness of migratory birds at the Site
Relative Abundance Surveys	Manage and conserve significant wildlife species and bird species numbers and richness; comply with Endangered Species Act, other Federal Acts, and Colorado wildlife protection statutes.	16 Transects	12 times per year	Track changes in numbers, richness, and habitat dependence of significant wildlife species (including birds) at the Site
Sitewide Significant Species Surveys	Manage and conserve significant species numbers and richness; comply with Endangered Species Act, other Federal Acts, and Colorado wildlife protection statutes.	1 Sitewide Survey (Follows all passable Buffer Zone roads.)	12 times per year	Track changes in numbers, richness, and area use of significant wildlife species at the Site
Preble's Mouse Trapping Surveys	Monitor and conserve viable Preble's mouse populations in appropriate habitat, and monitor and conserve current coverage of characteristic Preble's mouse habitat. Comply with Endangered Species Act and Colorado wildlife protection statutes.	Approx. 4 locations per year based on previous year's results	2 times per year (800 trap-nights per location per year)	Monitor presence, relative populations, and habitat dependence of Preble's mouse at the Site
High-Value Vegetation Surveys	Monitor and conserve unique and rare vegetation communities and develop management strategies for their protection and enhancement.	44 Management Units	2 times per year	Track changes in numbers and richness of plant species, health of plant communities, and changes in areal extent of high-value vegetation communities
Weed Control Monitoring	Monitor the noxious weeds at the Site; comply with weed control regulations.	Variable by year	2 times per year	Evaluate effectiveness of, and aid in outyear planning for, weed control actions at the Site
Controlled Burn Monitoring	Monitor the effectiveness of controlled burning as a management tool for conservation and enhancement of high-value vegetation communities.	Variable by year	2 times per year	Evaluate effectiveness of, and aid in outyear planning for, controlled burning actions at the Site
Project-Specific Compliance Monitoring	Monitor for the presence, or potential presence of special-concern, threatened, or endangered plant and wildlife species and wetlands; comply with Federal, State, and local protection and conservation regulations.	Variable by year	*As required*	Ensure compliance of projects with applicable ecological regulations and protect rare, threatened, and endangered species from harm

5.2 SCOPE OF MONITORING

Site ecologists conduct several types of monitoring in all five vegetation communities, as well as some activities specific to one or more communities. Common to all five vegetation communities are the following activities:

- Define the extant area of the community.
- Provide baseline estimates of the presence of birds and mammals, and estimate the baseline species richness of plant, bird, and mammal populations (plant species richness baseline will be determined from 1993–96 data, and bird and mammal baseline was established in the *1995 Annual Wildlife Survey Report*).
- Identify rare or imperiled plant or animal species.
- Make annual estimates of plant, bird, and mammal species richness (plant data are collected in the spring and summer to ensure that spring ephemerals and late-maturing plants are recorded, and bird and mammal species richness is measured monthly).
- Conduct weed mapping and photo surveys (photo surveys are conducted in both summer and winter in woody communities, and annually in grasslands).
- Make annual assessments of endpoints for the vegetation community and wildlife populations.
- Monitor the presence of noxious weeds and the effects of weed control efforts.
- Anticipate impacts from proposed Site projects, and estimate the potential area affected.

Ecologists also monitor the presence of noxious weeds and changes in plant community characteristics in areas not included within the five vegetation communities defined above.

5.2.1 Preble's Meadow Jumping Mouse

Populations of Preble's meadow jumping mouse have been identified within areas of tall upland shrubland and Great Plains riparian woodland. Monitoring activities in these areas include:

- Making annual estimates of plant species richness, density, height, and canopy cover.

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- Characterizing baseline Preble's mouse populations (based on all monitoring through 1996) and monitoring the source populations over time. Monitoring concentrates on determining the presence or absence of the species; quantitative population measurements are not appropriate because of its rarity. Monitoring data provide a basis for tracking ratios of males to females and adults to juveniles, enabling population viability to be confirmed. Ecologists monitor the known population areas on a rotating basis through a 2- to 3-year period, depending on results from the previous field season. They trap during May through September, because the mouse hibernates over the winter months.

5.2.2 Wetlands

In addition to the activities listed above, the U.S. Army Corps of Engineers determines the extent of wetlands at the Site every five years. They will conduct the next wetlands evaluation in the year 2000. A comprehensive plan[3] to manage and protect Site wetlands was issued in 1997, detailing the methods and procedures that will be used to identify wetlands and minimize impacts to them from Site closure and remediation projects.

5.2.3 Project-Specific Monitoring

Proposed Site projects will be evaluated in terms of potential effects on threatened and endangered (T&E) species, species of special concern (SSC), and migratory birds and wetlands. Much of the data for such evaluations will come from the monitoring activities listed above, but additional data needs may be identified to assess the impact of such projects in specific areas. Project-specific data needs may include:

- Seasonal presence or absence of affected species, and the seasonal timing of the proposed project
- Presence of habitat considered suitable for T&E and SSC species
- Biological characteristics of species of concern (feeding and nesting habits, home range, habitat preference), and potential effects of the proposed project.

Proposed projects will also be evaluated in terms of their impacts to migratory birds and Site wetlands (wetlands include both those mapped by the U.S. Army Corps of Engineers and those not included on the map).

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[3] K-H. 1997. Site-wide wetland comprehensive plan for the Rocky Flats Environmental Technology Site. Prepared for Kaiser-Hill Company, LLC, by PTI Environmental Services, Boulder, CO.

5.3 DATA DISPOSITION

Ecological data have historically been stored in two databases (the Ecological Monitoring Program Database [EcMPD] and the Sitewide Ecological Database [SED]). Because extracting data for specific purposes requires a high degree of system-specific knowledge, the two databases are being combined.[4] The new database will allow for multi-user access (with security restrictions), and ease of use with minimal training.

5.4 REPORTING

A comprehensive ecological management plan[5] is in place, setting forth the management actions that will be required to preserve the valuable ecological resources present at the Site. Site ecologists will update or modify this plan as required by variations in Site conditions, available technology, or changing regulations.

The Ecological Monitoring Program issues the following reports annually:

- Wildlife survey report (including a status report on the Preble's meadow jumping mouse)
- Site vegetation report.

The overall Site Integrated Weed Control Strategy report[6] and the Weed Control Strategy and Integrated Treatment Plan are issued annually to document planned weed control efforts.

Additional reports are issued as necessary to document baseline conditions of plant communities or wildlife populations.

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[4] K-H. 1997. Database development plan for the Rocky Flats Environmental Technology Site. Prepared for Kaiser-Hill, LLC, by PTI Environmental Services, Boulder, CO.

[5] K-H. 1997. Ecological resource management plan for Rocky Flats Environmental Technology Site. Prepared for Kaiser-Hill, LLC, by PTI Environmental Services, Boulder, CO.

[6] K-H. 1997. Integrated weed control strategy for the Rocky Flats Environmental Technology Site. Prepared for Kaiser-Hill, LLC, by PTI Environmental Services, Boulder, CO.

6. INTERACTIONS AMONG MEDIA

Interactions among groundwater, surface water, air, and soils influence ecological conditions both on Site and potentially at off-Site locations (see Table 6-1 of the IMP Background Document). Also, activities upgradient from the Site (e.g., aggregate mining to the west) can affect the ecology on the Site, as well as downgradient off the Site. The monitoring described in the previous sections generally will detect the results of such interactions. For example, surface water quality may be affected by perturbations in groundwater quality, and monitoring data will both identify the variations in surface water quality and serve to trace those effects to groundwater.

Soil chemistry can also affect air, surface water, and groundwater quality. Soils are not monitored routinely as part of the Integrated Monitoring Program, but project-specific soils are sampled and analyzed to assess potential effects of any site closure activities.

Significant habitat effects could accrue from upgradient off-Site activities, as well as on-Site projects, and variations in water supply could affect on-Site and downgradient off-Site habitats. Therefore, to gather data beyond those generated by the monitoring programs described previously, Site personnel collect watershed-level information to assess water availability in the Buffer Zone. Instruments continuously monitor flow at 15 Site locations, and personnel collect seasonal grab samples from seven of those locations for chemical analysis to assess compliance with various regulations (see Table 6-2 in the IMP Background Document).

Site-specific correlations between ecological health and water availability have not been quantified, so DQOs were not developed for this phase of monitoring. However, personnel compare the watershed-level data to baseline values, to serve as an early warning of potential habitat effects that could result from water supply depletion.

The integrated monitoring working group continues to address the issue of integrating water and ecological monitoring. Unless the group decides it is no longer necessary, data will continue to be gathered. The scope and types of data may change if additional data needs are identified.